Mercury Polar Flyby Mission Design

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Abstract

The Mercury Polar Flyby (MPF) is a proposed low-cost mission to return to Mercury with two focused science objectives. The objectives are: 1) to investigate the suspected presence of water ice on Mercury's polar caps which has been inferred from the earth based radar observations, and 2) to complete the geological reconnaissance of Mercury by imaging the half of the planet unseen by Mariner 10.

The spacecraft is based on a Lunar Resource Mapper design developed by Boeing. Boeing designed the Mariner 10 spacecraft and brings important design experience for a very Mariner 10-like mission. The instruments on board the spacecraft are; a narrow angle camera, a Thermal Emission Spectrometer, a Neutron/X Ray Spectrometer and a Radar Sounder-Scatterometer.

The mission design challenges are in finding multiple encounter opportunities that meet the following criteria: 1) To have a reasonable flight time. and as attractive mass performance; 2) The encounters are to be at Mercury aphelion to ease the thermal design; 3) To be able to accommodate specified flyby sequences (e.g. North Pole - Equator - South Pole); and 4) Each encounter must meet specific encounter conditions (e.g. range, viewing angle, imaging coverage that will complete the map etc.)

Several opportunities to conduct quality MPF mission have been found This paper presents the available mission opportunities and the search procedures used to identify them. A detailed description of one nominal mission containing trajectory design, end-to-end scenario, performance, science observational conditions and spacecraft design requirements is provided.